Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] What is claimed is:

1.A flat-panel direct methanol fuel cell (DMFC), comprising:

an integrated cathode electrode sheet comprising a first substrate, a plurality of cathode electrode areas, a plurality of first conductive via through holes, wherein the cathode electrode areas is electroplated on a front side and backside of the first substrate and has a plurality of apertures therein, wherein the first conductive via through holes are disposed outside the cathode electrode areas and is electrically connected to respective cathode electrode areas with a conductive wire;

a membrane electrode assembly (MEA) unit comprising a plurality of proton exchange membranes corresponding to the plurality of cathode electrode areas;

an intermediate bonding layer comprising at least one bonding sheet, wherein the intermediate bonding layer comprises a plurality of openings for respectively accommodating the plurality of proton exchange membranes, and a plurality of second conductive via through holes that are aligned with the first conductive via through holes;

an integrated anode electrode sheet comprising a second substrate, a plurality of anode electrode areas corresponding to the plurality of cathode electrode areas, , wherein the cathode electrode areas is electroplated on a front side and backside of the second substrate and has a plurality of apertures therein, and a plurality of conductive pads are disposed outside the anode electrode areas and corresponding to the second conductive via through holes; and
a fuel container.

[c2] 2.The flat-panel direct methanol fuel cell of claim 1 wherein the cathode electrode area comprises a copper clad base layer, a chemically deposited copper layer on the copper clad base layer, an electroplated copper layer on the chemically deposited copper layer, and a conductive protection layer on the electroplated copper layer.

[c3] 3.The flat-panel direct methanol fuel cell of claim 2 wherein the conductive protection layer comprises Ni/Au.

[c4] 4.The flat-panel direct methanol fuel cell of claim 1 wherein proton exchange membrane is a solid-state proton exchange membrane.

[c5] 5.The flat-panel direct methanol fuel cell of claim 1

wherein the bonding sheet is made of Prepreg B-stage resin.

[c6] 6.The flat-panel direct methanol fuel cell of claim 5 wherein the Prepreg B-stage resin can be completely cured at about 140℃ for a time period of about 30 minutes.

[c7] 7.The flat-panel direct methanol fuel cell of claim 1 wherein the first substrate is made of glass fiber reinforced polymeric materials.

[c8] 8.The flat-panel direct methanol fuel cell of claim 7 wherein the glass fiber reinforced polymeric materials comprises ANSI-grade FR-1, FR-2, FR-3, FR-4, FR-5, CEM-1 or CEM-3.

[c9] 9.The flat-panel direct methanol fuel cell of claim 1 wherein, in assembly, the MEA unit is installed into the openings of the intermediate bonding layer, which is then adhesively sandwiched by the integrated cathode electrode sheet and the integrated anode electrode sheet, wherein the conductive via through holes of the integrated cathode electrode sheet are aligned, and in contact, with respective conductive via through holes of the intermediate bonding layer, which are aligned with the conductive via through holes of the integrated thin

anode electrode sheet.

[c10] 10.A method for fabricating an integrated cathode electrode sheet of a flat-panel direct methanol fuel cell, the method comprising:
providing a CCL (copper clad laminate) substrate comprising a base layer, a first copper layer laminated on an upper surface of the base layer, and a second copper layer laminated on a lower surface of the base layer;
drilling the CCL substrate within pre-selected electrode areas to form a plurality of apertures through the first copper layer, the base layer and the second copper layer;
chemically depositing a third copper layer on the CCL substrate and interior sidewalls of inside the apertures;
forming a patterned resist layer on the CCL substrate to expose the pre-selected electrode areas;
using the patterned resist layer as a plating mask, performing an electroplating process to electroplate a fourth copper layer within the expose the pre-selected electrode areas and area not covered by the patterned resist layer, and then electroplating a Sn/Pb layer on the fourth copper layer;
stripping the patterned resist layer;
performing a copper etching process to etch away the third copper layer and the first and second copper layer that are not covered by the Sn/Pb layer; and

removing the Sn/Pb layer to expose the fourth copper layer.

[c11] 11.The method according to claim 10 wherein after removing the Sn/Pb layer, the method further comprises the following steps:
coating a solder resist layer outside the pre-selected electrode areas; and
electroplating a conductive protection layer on the fourth copper layer.

[c12] 12.The method according to claim 11 wherein the conductive protection layer comprises Ni/Au.

[c13] 13.The method according to claim 11 wherein the conductive protection layer comprises Sn/Pb.

[c14] 14.The method according to claim 11 wherein the conductive protection layer comprises chemical silver.

[c15] 15.The method according to claim 10 wherein the apertures occupy at least 50% the surface area of the pre-selected electrode areas.